# A Software Package for Studies on Spacecraft Entry in Planetary Atmospheres.

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A computational tool for predicting the trajectory and decay lifetime of a spacecraft when entering a planetary atmosphere has been developed. Emphasis is on modularity, easy development, availability and portability. The MATLAB environment, with huge collections of pre-defined functions (m-files), is adequate for meeting the requirements. Modularity and development of new features are easy to get since the functions are implemented through independent m-files and can take advantage from a pre-developed library of functions.

The flexibility of the software environment allows one, once the basic structure is defined, to implement any features thought relevant for the problem to be solved. With the correct data available one can easily simulate descents in different planets taking into account all the relevant aspects of the problem e.g. n-bodies perturbations, planetary non-spheriodicity effects (to the desired order), radiation effects, etc. The characteristics of the planetary atmospheres play a crucial role in the validity of the results and require special attention. With this approach, it is relatively easy to implement the most up-to-date models available for atmospheres. For example, it is possible to opt between different density profiles for the atmosphere, from the basic exponential decay to a sophisticated model based on experimental data that takes into account all the relevant features, namely atmosphere expansions due to the 11-year solar cycle.

On the other hand it is necessary to have information, or a way to estimate it, on the intrinsic features of the object to study: dimensions, mass, drag coefficient, lift, etc., and special events that could take place: disintegration due to adverse conditions (inadequate attitude), the nature of the object, etc. Estimates of the final decay location and time are possible, taking into account e.g. planetary equatorial bulge and winds. It is also possible to study the 'inverse problems': starting with a known trajectory, to make better estimates of (in particular) the atmospheric parameters and to improve the models. Include, exclude and/or alter parameters of the force model, the atmospheres, etc., useful for studying and identifying causes of specific physical effects, is possible as well.

This computational tool has a broad range of potential applications, from space debris and satellite decay studies to planetary descent probes and planetary and terrestrial atmosphere studies. Possible extensions in the future should include ways to deal with the uncertainty of the parameters in the models towards a better and faster error estimate of the results.